Chapter 2. Affected Environment

2.1 Facilities

The general layout of Fort Richardson is shown in Figure 2-1. The cantonment area encompasses 5,760 developed acres located along the Glenn Highway near the center of the post. This area contains 568 buildings with 7,609,513 square feet of floor space. The post provides housing, facilities and activities that add up to good military living. There are community services, medical and dental facilities, excellent churches, schools, libraries, crafts shop, newspaper, theater, golf and ski courses, and cross country trails, along with a post exchange, commissary and a large physical fitness facility.

Fort Richardson's remaining 55,000 acres are comprised of maneuver and impact areas (US Army Alaska, Undated). The 44,071 acres of maneuver area include 42,898 acres of training area. The post has major ranges (Figure 2-1) in addition to artillery and mortar firing points. These include small arms ranges, large ranges, landing zones, and drop zones.

2.1.1 Range Facilities

All areas outside of urban areas are defined as range facilities. Range facilities can be further broken down as follows:

- Firing Ranges
- Impact Areas
- Training Areas
- Drop Zones / Landing Zones
- Artillery Firing Points

2.1.1.1 Firing Ranges

- Mahon Range
- Fieldfire Range
- Statler-Newton Small Arms Range for .38 and .45 caliber pistols
- Oates-McGee Range for M-60 firing at 500 to 1,000 feet
- Grezelka Range for M-16 and M-60 training and qualification
- Zero Range
- Record Range for M-16 qualification
- Pendeau Range for M-16 and M-14 training
- Grenade Range
- Shoot House Range
- Off-Duty Range
- 40 mm Range
- Davis Range Complex (1,333 acres) for live fire training; includes a platoon battle course, a defensive trench system, ambush and defensive sites, and several live fire courses
- Biathlon Range (692 acres) used for training in Arctic combat; has three ski trails and an arms range for firing M16 and 22 caliber rifles
- Aerial Target Range for training in engagement techniques for aerial targets
- Demolition Range
- McLaughlin Range Complex (692 acres) used for live fire training of the LAW AT4 and Mark 19

2.1.1.2 Other Range Facilities

- ERF Impact Area for mortar and artillery firing from approximately 30 firing points on North Post
- Malemute Drop Zone (214 acres, which is being expanded by 200-300 acres); used to support of strategic airborne operations; and can support a company size operation
- Landing Zones (about 25) for helicopter assaults
- Another significant training facility is the Squad Obstacle Training Course, which consists of rope bridges and cliff rappelling sites.

2.1.2 Transportation System

Fort Richardson is bisected by the Glenn Highway (US Highway 1), which provides primary access to the post. It is the most heavily used highway in the state, connecting southcentral Alaska to the Matanuska Valley. It continues northeast past the Richardson Highway at Glennallen to intercept the Alaska Highway at Tok (Figure 2-2).

Northeast of Fort Richardson, a few miles south of Palmer, the Parks Highway (US 3) intercepts the Glenn Highway and provides the only highway link directly north to Mount McKinley National Park and Fairbanks. Richardson Drive passes through the heart of the cantonment area, connecting Fort Richardson with Elmendorf AFB.

The Alaska Railroad provides rail service to Fort Richardson. Its mainline crosses the post north of the cantonment area and a spur extends to a loading facility and an ammo storage complex. The railroad provides both freight and passenger service with access to Fairbanks and two unique port facilities: (1) the port of Whittier, and (2) Seward, which is a deep water port at the southern terminus of the railroad. Here, intermodal traffic from Sea-Land Freight Service, Totem Ocean Trailer Express, Alaska Lynden Transport and other sources is transferred to and from ships.

The airfield at Elmendorf AFB provides Fort Richardson's primary air link. Located adjacent to Fort Richardson and roughly 2.5 miles from the center of the cantonment area, the airfield can support any type of military aircraft including Galaxy C5s.

Bryant Army Air Field (AAF), located adjacent to the cantonment area and the Glenn Highway, has a main, hard-surfaced, north/south runway, which is 3,000 feet in length. It also has a hard-surfaced crosswind runway oriented east/west. Bryant AAF is used primarily by the Alaska Army National Guard as a base for their fixed-wing and rotary aircraft. Large parking aprons and several hangars are located on the airdrome.

Anchorage International Airport, 15 miles southwest of Fort Richardson, is the nearest commercial airport. It is the largest airport in Alaska for both passenger and air cargo operations. More than 30 carriers provide passenger service in the recently renovated airport. It is the largest air cargo handler and transfer site in the United States.

Anchorage lies near the head of Cook Inlet at the mouth of the Knik Arm, an important navigable waterway. Access to the Inlet was influential in siting for original settlements in the Anchorage area. USARAK operates a deep water sea port and fuel terminal on Knik Arm, immediately north of downtown Anchorage.

2.1.3 Water Supply

Fort Richardson's water is supplied primarily by Ship Creek, which traverses Fort Richardson from east to west for approximately eight miles. Ship Creek "high dam", with a structural height of 50 feet, forms a reservoir that impounds approximately 5 million gallons of water at maximum capacity. The "high dam" and intake facilities are located on the post near the base of Ship Creek Canyon. All of the domestic water for Fort Richardson and Elmendorf AFB comes from the reservoir. Anchorage also receives part of its water supply from Ship Creek. Water from the creek is excellent quality and exceeds drinking water standards set by the Environmental Protection Agency (EPA). A water treatment plant is located near the dam and is used for extraction of sediments and minor chemical processing with chlorine and fluoride. Fort Richardson also maintains three groundwater wells, each approximately 100 feet deep, as an emergency supplemental water supply to Ship Creek surface water. Water from the wells is virtually pollution-free due to protection of the deep aquifer by a dense confining substratum (Gossweiler, 1984). More information regarding Ship Creek and the Ship Creek Dam can be found in the publication *Chronology of Water Use and Water Rights on Ship Creek* (Quirk, 1997).

The Ship Creek floodplain upstream of the Glenn Highway has received minimal disturbance in past years, however, a new golf course constructed in 1997 has reduced the riparian vegetation associated with the creek. More importantly, the "high dam", constructed in 1952, has, and continues to, severely affect the creek's hydrology and stream dynamics.

The portion of Ship Creek on Fort Richardson that is west of the Glenn Highway has been more severely impacted over the years. The creek bottom from Cottonwood Park to the Central Heat and Power Plant has been channelized and the north bank has been stabilized to prevent erosion. Near the power plant is a low dam and intake pond that supplies water for power plant operation. West of the Fort Richardson Fish Hatchery is a cooling pond, which empties into Ship Creek. The fish hatchery has several water wells that were drilled in the shallow aquifer near Ship Creek. The wells are used to supply fresh water for the raceways in the hatchery. A bridge carrying a steam line crosses Ship Creek about a half mile downstream from the power plant. The remainder of Ship Creek to the Elmendorf AFB boundary is for the most part in a natural condition and has not been disturbed.

2.1.4 Projected Changes in Facilities

There are few projected changes in facilities that will have significant impacts on natural resources management at Fort Richardson. Most of these changes involve construction projects within the cantonment area on sites already developed and cleared of forests. Facility changes with potential impacts on natural resources include:

- The Elmendorf AFB hospital and adjacent housing area, which is under construction on former Fort Richardson lands
- Expansion of Malemute Drop Zone requiring the removal of up to 300 acres of mature forests
- Future development of the National Guard area requiring up to 200 acres

2.2 Physical resources

2.2.1 Topography

Fort Richardson lies between the Turnagain Arm and the Knik Arm of the Cook Inlet in a roughly triangular-shaped lowland. To the east, the Chugach Mountains rise abruptly to elevations over 5,000 feet. From an elevation of 1,000 feet at the base of the mountains, the land declines into the Anchorage plain to the coast. The Anchorage plain is a glacial moraine that extends from the mountain front westward and northwestward. Steep bluffs, broken only by principal streams such as Eagle River, characterize the edge of the plain as it drops sharply to the sea (CH2M Hill, 1994b). Figure 2-3 illustrates the topography of Fort Richardson.

2.2.2 Geology

Geology of the Fort Richardson area was shaped by the formation of the Chugach Mountains in the late Paleozoic and Mesozoic Eras and the subsequent flow of sediments into lowlands during the Tertiary period (Gossweiler, 1984). The Chugach Mountains have a bedrock of metamorphic rocks of the McHugh complex composed of a mixture of metamorphose siltstone, lithic sandstone, arkose, and conglomerate sandstone (CH2M Hill, 1994b). The lowland's bedrock is composed of sedimentary rocks of conglomerate sandstone, mudstone, and coal. It is connected with metamorphic rocks of the mountains along the vertical Border Ranges Fault, that lies at the base of the Chugach Mountains (CH2M Hill, 1994b).

Bedrock in lowlands rarely surfaces, because it is covered by thick deposits of unconsolidated material that accumulated during the Holocene Period, one million to ten thousand years ago (Gossweiler, 1984). These surface deposits begin at the mountain front and thicken as they slope downward to Cook Inlet. Thickness varies from zero at the foot of the mountain range to 900 feet at Point Woronzof (CH2M Hill, 1994b). The upper part of the deposits is composed of gravel and sand ranging from 30 to 100 feet thick. Underlying the gravel is Bootlegger Cove Clay, a 60 to 200 foot layer of clay and silt with interbeds of sand. Below the clay is a 100 to 200 foot layer of sand and gravel that provides the major groundwater aquifer for the area (CH2M Hill, 1994b). Between the aquifer layer and the bedrock is a layer of poorly sorted glacial sediments (Gossweiler, 1984).

Bootlegger Cove clay is nearly impermeable and serves as a confining layer between upper and lower gravel layers. It inhibits downward flow of pollutants from groundwater in upper layers and results in an artesian aquifer in the lower gravel layer. Water from this aquifer flows into the Knik and Turnagain Arms at an estimated rate of 75 million gallons per day (CH2M Hill, 1994b).

The northern third of the Anchorage lowland consists of a complex of glacially deposited materials. These materials include morainal deposits of the Elmendorf Moraine, marking the margin of the former glacier occupying Knik Arm. Other glacial deposits consist of diamicton and other unsorted and poorly sorted till material and glacial alluvium, including glacial outwash gravel, kames, and kame terraces deposited at the edge of the former glacier (CH2M Hill, 1994b).

Fort Richardson straddles both the alluvial fan of the Anchorage plain and the moraine and glacial alluvium complex near the shore of Knik Arm. The gravel alluvium of the Anchorage plain underlies the main cantonment. Well-bedded and well-sorted gravel and sands provide good foundation conditions and plentiful construction material. The confined gravel aquifer is 200 feet to 400 feet below the surface in this area of the post (Selkregg, 1972). Groundwater flow in this confined aquifer is generally west to northwest (CH2M Hill, 1994b).

Just north of the cantonment area is the southern edge of the Elmendorf Moraine, a long series of ridges running east-west across Fort Richardson and Elmendorf AFB, roughly parallel to Knik Arm. Elevations of the moraine rise to more than 300 feet, especially in the west. The moraine is chiefly till, including diamicton and poorly sorted gravel. North of the Elmendorf Moraine is a complex of moraine and glacial alluvium deposits in the form of irregularly shaped hills (CH2M Hill, 1994b).

The complex of hills just south of ERF is part of this glacial alluvium deposit. Further north, on either side of ERF, are more moraine deposits. These deposits are more subdued in topography than the Elmendorf Moraine (CH2M Hill, 1994b). Fort Richardson surface geology is shown in Figure 2-4.

2.2.2.1 Seismic Activity

Seismic activity in Alaska is greater than any other state in the Union. On Good Friday, March 27, 1964, southern Alaska experienced the strongest recorded earthquake in American history, estimated to be over 9.0 on the Richter scale. The quake's epicenter was approximately 80 miles east of Fort Richardson in Prince William Sound. Although the Anchorage area did not experience great loss of life, damage from the quake was considerable. Fissures in the Bootlegger Cove Clay led to land slides in business and residential areas of Anchorage that caused extensive property damage. Total damage to Fort Richardson was assessed at $17 million.

The Fort Richardson area is seismically active and has experienced at least nine major earthquakes in the last 85 years. The area has also experienced tremors and ash fall from volcanic eruptions of Mount Spurr, Mount St. Augustine, and Mount Redoubt since 1954. Two faults, the Border Ranges Fault and the Bruin Bay-Castle Mountain Fault, border Anchorage. The Border Ranges Fault bisects Fort Richardson, running parallel to the base of the Chugach Mountains (Elmendorf AFB, 1994). Another fault, located in the Chugach Mountains, skirts the Ski Bowl area of the post.

2.2.2.2 Petroleum and Minerals

Leasing and permitting for petroleum and mineral extraction on Fort Richardson is handled by the BLM. Prior to issuance of a permit that allows these activities, the Army must concur and sign a statement of non-objection.

There has been no interest in oil and gas exploration on Fort Richardson because no oil-bearing basins are known to underlie the post. Potentially significant mineral and organic resources on the post include coal, gravel, sand, and peat. While coal is found on the post there have been no surveys to inventory the resource, nor is coal extraction likely to occur because there are vast known reserves north of Anchorage at Jonesville and on native-owned lands west of the village of Tyonek.

The most valuable and desirable mineral resource on Fort Richardson is gravel, that is used in highway, utility, and building construction projects. The Alaska Department of Transportation has repeatedly requested permission to extract gravel from Fort Richardson for construction on Glenn Highway and other nearby highway projects in Anchorage. As a result of these requests, 20 or more sites have been approved for gravel mining. Many of these sites are located along the Glenn Highway in the gravel-rich Elmendorf Moraine (see Figure 2-3).

There are other gravel quarries (e.g., Otter Lake and Artillery Road) where gravel is extracted and used for Fort Richardson construction projects. One commonly used pit is near Bryant Army Airfield. Public service utility projects (e.g., electrical transmission lines, water mains, sewer, natural gas and petroleum pipelines) that pass through Fort Richardson use gravel obtained from the post for their projects.

Small sources of sand can be found on the post. Two areas have been developed for extraction, one in the Ammo Storage area and another adjacent to McVeigh marsh. Both have been closed due to impacts in sensitive areas. Peat is found in wetlands on the post, and it has been extracted from several areas for use in landscaping applications.

2.2.3 Soils

2.2.3.1 General

The relationship between vegetation and soil formation is inseparable. The history of soil development in the Fort Richardson area began when the Cordilleran Ice Sheet covered southcentral Alaska during the Wisconsin Glaciation, 10,000 to 15,000 years ago. Climates began to warm and ice sheets melted in the late Wisconsin Glacial Period due to changes in the Earth's orbit around the sun. Sediment cores from lakes on the Kenai Peninsula lowlands show that plant life returned to this area about 14,500 years ago (Elias, 1995). The earliest vegetation to become established was herbaceous tundra dominated by sedges, grasses, sage, and plants in the composite family. By 13,700 years ago, the herbaceous tundra gave way to shrub tundra dominated by dwarf birch and heath plants. Deciduous forest became established by 10,300 years ago. Dwarf birch gave way to a mixture of cottonwood, balsam popular, aspen, and willow. Conifer trees appeared in the Kenai lowlands about 8,000 years ago. These first conifers were thought to be white and black spruce. Although no pollen records have been collected and analyzed in the Anchorage area, including Fort Richardson, the development and progression of the vegetative communities after the ice sheets melted are thought to closely follow the patterns found on the Kenai. Recent glacial studies indicate that the ice sheets on Fort Richardson melted about 1,000 to 1,200 years after the ones on the Kenai (Hunter et al., 1997).

Soil development is determined by five primary factors: parent material, vegetation, topography, climate and time. Vegetation is a dominant factor of soil development and vegetative succession at Fort Richardson is thought to follow closely with the records obtained from Hidden Lake on the Kenai Peninsula with a time delay of about 1,000 to 1,400 years later. Therefore, the vegetation communities and soils on Fort Richardson would be about 1,000 years younger than the Kenai development. Boreal forests on Fort Richardson would have been expected to have evolved some 7,600 to 8,000 years ago.

Soil development on Fort Richardson from weathering of glacial deposits and the vegetative succession described above would be expected to be very slow. The present day description of soils bear out this expectation. The modern soils are immature and shallow. The thin A and B horizons are often irregular or broken. Coarse gravels and larger rock fragments from glacial till are omnipresent in all soil horizons. The lowland area on Fort Richardson supports coniferous or mixed coniferous-hardwood forests. These forest soils are acidic and the lower part of the A horizon usually has a thin and often discontinuous layer of grayish-white or ash colored material. The ash colored layer is the result of highly leached A horizon and is typical of coniferous forest. These soils are typically called Podzols.

Fort Richardson's soils are shallow, immature and deficient in the primary plant nutrients, especially nitrogen and phosphorous. In addition, they often exhibit low water retention capability, making them a primary limiting factor for vegetative growth during dry periods. In depressions and saturated areas, such as wetlands, surface horizons may be covered with partially decomposed herbaceous vegetation called peat. Fort Richardson soils are shown in Figure 2-5.

2.2.3.2 Soil Survey

This section contains descriptions of major soil series occurring on Fort Richardson. These are taken from the Soil Conservation Service (SCS, now known as the NRCS) study (SCS, 1979).

Homestead series: Homestead silt loam is the most common type of soil on the post. It is a shallow, well-drained soil formed in loess over very gravelly drift on moraines and outwash plains. Terrain varies from level, to rolling, to strongly sloping. Permeability is moderate to moderately rapid. Runoff ranges from slow to very rapid, and the erosion hazard is slight to severe.

Purches series: This moderately well-drained to somewhat poorly-drained silt loam is found on muskeg borders and slight depressions in glacial moraines. It has a surface layer of black silt loam and a subsurface layer of gray silt loam. The subsoil is mottled dark brown and the substratum grayish brown. It was formed in glacial till. Terrain is smooth to moderately sloping. Permeability is moderate to moderately slow in the more compact till. Available water capacity is low, and erosion hazard is low to moderate.

Kasilof series: This excessively drained silt loam is found on outwash plains and stream terraces. It was formed in a thin mantle of loess over very gravelly alluvium. The surface layer is dark gray silt loam. Subsoil is dark brown gravelly loam, and the substratum, dark olive gray, very gravelly sand. Runoff is slow to rapid, and erosion hazard is slight to severe. This soil series is a potentially severe threat for flash flooding.

Jacobsen series: This very stony silt loam is poorly drained and found in small valleys, shallow depressions, and low-lying areas bordering muskegs. It was formed in very stony glacial till. A typical soil profile has a peaty surface mat covering a black, very stony silt loam layer. Stones and cobbles make up about 40 percent of the volume, and gravel makes up about 20 percent. The water table is normally less than two feet below the surface. Permeability is moderate, and erosion hazard slight.

Doroshin series: This soil series is comprised of peat over a substratum of dark greenish gray silt loam. It is poorly drained and found in muskeg borders and depressions in glacial moraines. Permeability is moderate. Runoff is very slow to moderate, and erosion hazard slight.

Salmatof series: This soil is comprised of dark reddish brown coarse peat materials. It is very poorly drained and occurs in broad basins and depressions. The water table is usually near the surface.

Tuomi series: This silt loam soil is well drained and occurs on low moraines. The soil consists of silt loam over sandy loam and has moderate permeability. Runoff is slow to medium, and hazard of erosion slight to moderate.

Slikok series: This soil is a mucky silt loam occurring in valley bottoms and low areas around lakes or muskegs. The soil has a peaty surface layer. Terrain is nearly level. The soil has a high water capacity and a moderate permeability. Surface runoff and erosion hazard are moderate.

Caswell series: This series consists of coarse silt loam formed in silty and sandy waterlaid sediments over gravelly sand. It occurs on low terraces and in broad depressions. Water capacity is moderate, and permeability moderate to rapid. Surface runoff is slow, and erosion hazard is slight. The water table is normally two to four feet below the surface.

Clam Gulch series: This series consists of deep, poorly-drained silt loam that occurs in flood plains and in depressions in glacial moraines. It has dark silt over gray sediments that are high in clay. Water capacity is high, and the water table is often near the surface. Surface runoff is slow to rapid, and erosion hazard is slight to severe.

Chena series: This series consists of sandy-skeletal silt loam that is excessively drained. It occurs in alluvial fans and flood plains. The substratum contains 35 to 50 percent gravel and up to 10 percent cobbles. Permeability is moderate to rapid, and water capacity is low. Surface runoff is slow, and erosion hazard is slight.

Niklason series: This series is characterized by coarse silt loam occurring on flood plains and broad low-lying stream terraces. Soil is dark grayish brown silt loam and fine sand over gravelly sand. Water capacity is moderate to low, and permeability is moderate to rapid. Surface runoff is slow, and erosion hazard slight. This soil is susceptible to flooding, but is a good source of sand and gravel.

2.2.4 Water Resources

2.2.4.1 Surface Water

Fort Richardson's surface water resources are diverse and include numerous streams, lakes, ponds, and a saltwater tidal bay. Figure 2-6 indicates the location of surface water resources on the post.

The quality of surface water on Fort Richardson appears to have remained good throughout the Army's occupation of the area. There is no reason to suspect that these waters have either degraded (beyond localized, temporary sedimentation) or improved.

Water samples were collected from the Eagle River at three locations on two occasions. Sampling locations were Chugach State Park Campground, Bailey Bridge, and the take-out point above the Route Bravo Bridge (Horne Engineering Services Inc., 1996). The first sampling effort occurred on May 26, 1995, and the second in August, 1995. Since problems have not been found, there has been only limited monitoring of surface waters at other locations.

2.2.4.1.1 Streams

Most streams on Fort Richardson flow from headwaters in the Chugach Mountains to the Cook Inlet (saltwater), and traverse the post in a westerly direction. Eagle River is fed by a glacier. Flow volume of streams fluctuates dramatically from season to season. During the long period of freeze, usually from October to April, flow is limited to groundwater seepage from aquifers into streams. Snowmelt typically begins in April and reaches its peak in June; stream flow is greatest during the months of June and July. After July most of the snow has melted, but the stream flow during the months of August and September remains steady because it is augmented by rainfall (Gossweiler, 1984).

Eagle River is the largest source of surface water on the post. It flows at an average rate of 519 cubic feet per second and drains approximately a 192 square mile watershed, characterized by both mountains and lowlands (CH2M Hill, 1994b). The Eagle Glacier comprises 13 percent of the watershed and snow and ice melting from the glacier is a major source of flow during the summer months (Gossweiler, 1984). River flow reaches its peak of more than 2,500 cubic feet per second during July and August. Periods of heavy rainfall or rapid melting from the glacier can generate water flow in excess of 3,600 cubic feet per second (CH2M Hill, 1994b).

Upstream of Fort Richardson, the Eagle River passes through the community of Eagle River. From there the river flows into the northwestern portion of the post and through the ERF tidal marsh before it empties into the Knik Arm of Cook Inlet (CH2M Hill, 1994b). In winter, the Eagle River is a clear stream with excellent water quality. During spring–summer, however, there are significant levels of suspended sediment from runoff and glacial melt (Gossweiler, 1984). Overall sediment loads, however, are fairly low in comparison with other glacially fed streams in Alaska (CH2M Hill, 1994b).

Besides the water that comes via the Eagle River, ERF is also fed by two small tributary streams, Otter Creek and Clunie Creek. Otter Creek is a perennial stream, which drains Otter Lake just north of the cantonment area, and then flows north into ERF. Clunie Creek, an intermittent stream, drains Clunie Lake and other small ponds among the moraines on the northeast portion of the post as it flows west into ERF (CH2M Hill, 1994b).

On Fort Richardson, Ship Creek is second only to Eagle River in volume. It drains a watershed of 117 square miles, 90 of which are in the Chugach Mountains. From the mountains the creek flows west across a coastal plateau through Fort Richardson,

Elmendorf AFB, and an industrial area of Anchorage before meeting Cook Inlet at the mouth of Knik Arm. Although there are no tributaries in these lowlands, the Anchorage area comprises 27 square miles of the creek's watershed.

Ship Creek traverses Fort Richardson from east to west for approximately eight miles. Entering the post, it initially flows through a three mile canyon of white water beginning at an elevation of 1,100 feet above sea level. Emerging from the canyon at an elevation of approximately 500 feet, it continues across the forested coastal plain to the western boundary of the post at an elevation of 230 feet. Ship Creek and its floodplain above the Glenn Highway is the least disturbed portion of the creek on Fort Richardson.

The Fort Richardson Dam on Ship Creek forms a sizable reservoir, which provides all the potable water for Fort Richardson and the Elmendorf AFB and nearly half the water for the Municipality of Anchorage. Fort Richardson and Anchorage have separate water treatment plants and delivery systems. Fort Richardson also has several backup water wells fed by a shallow aquifer along Ship Creek south of the post's Central Heat and Power Plant. Additional information regarding Ship Creek and Ship Creek Dam can be found in *Chronology of Water Use and Water Rights on Ship Creek* (Quirk, 1997).

Snowhawk Creek is a perennial tributary of Ship Creek flowing from its mountainous drainage basin. It drains a small cirque lake in the Chugach Mountains on the southern portion of the post and flows north through Snowhawk Valley into Ship Creek about six miles further downstream (Gossweiler, 1984). Chester Creek and the North Fork of Campbell Creek are the only other perennial streams on the post. Chester Creek drains a small basin located on the southern portion of Fort Richardson on the western slope of the Chugach Mountains. It flows northwest until it leaves the post. Although it is a shallow creek, it usually has a constant flow of water (Gossweiler, 1984).

In the winter of 1996–1997, the main and North Fork channels of Chester Creek were damaged during construction of the Municipality of Anchorage's 48-inch water transmission line. The damage occurred in a wetland area the creek passes through, near the western boundary of Fort Richardson, and adjacent to the Muldoon Community in east Anchorage. The main channel was blocked with ice and the creek overflowed onto the property of nearby homeowners. The threat of flooding homes caused the contractor to drain excess water into the city's storm drain. In addition to the flooding problem, the stream was improperly reconstructed across the pipeline right-of-way.

The ADF&G, the Alaska Department of Environmental Conservation, and the Alaska District, Corps of Engineers sent Notices of Violation (NOVs) to the Municipality of Anchorage Water and Wastewater Utility for violating existing stipulations for pipeline construction or for failing to obtain the required permits for the work performed. The improper alteration of Chester Creek was satisfactorily repaired in August 1997, and wetland vegetation plugs were transplanted adjacent to the creek. Other construction damage on the North Fork, where it crosses the pipeline right-of-way, resulted in the creek bottom being above grade causing alternating conditions of ponding and dewatering.

The North Fork of Campbell Creek drains a lake in the Chugach Mountains eight miles southeast of the post. It passes through Fort Richardson flowing northwest from the southern boundary to the western boundary. The creek is particularly scenic, and its water is quite clear. A waterfall is located in the southwest corner of the post (Gossweiler, 1984).

2.2.4.1.2 Lakes and Ponds

Fort Richardson has 12 named lakes and ponds and several unnamed water bodies. The combined area for the named lakes and ponds is 348 acres. Five relatively large lakes, Clunie, Otter, Gwen, Thompson, and Waldon, are managed for recreational fishing.

Clunie Lake (116 acres) is the largest lake on the post. It is picturesque and situated in the northern, moraine area of Fort Richardson. It attains a maximum depth of approximately 33 feet and drains into Clunie Creek (Gossweiler, 1984).

Otter Lake covers 93 acres and is the post's second largest lake. It receives the most fishing pressure. It is fed by a small creek on its southern end and drains into Otter Creek on its northern end. It attains depths of 23 feet (Gossweiler, 1984).

Gwen Lake is small and shallow with an area of 10 acres and a maximum depth of 11 feet. It is located two miles north of the cantonment area along a well-maintained road. Due to its small size and lack of depth, it cannot support fish over winter (Gossweiler, 1984).

Thompson Lake is smaller but deeper than Gwen Lake. Its eight acres make it the smallest of the actively-managed lakes on Fort Richardson. It attains a depth of 21 feet and can support fish over winter (Gossweiler, 1984).

Waldon Lake is approximately 50 acres. It is only about eight feet deep, therefore it may not support fish during some winters. This lake is easily accessed.

The other seven lakes and ponds on the post are: Chain Pond, Web Pond, Lake Kiowa, Dishno Pond, Cochise Lake, Diablo Pond, and Snowhawk Lake. Snowhawk Lake is located in the southeastern corner of Fort Richardson and is the largest and least accessible of the seven. None of these other lakes or ponds support a fishery, except Dishno Pond which is stocked annually with catchable-sized rainbow trout for flyfishers. About 80 percent of Campbell Lake lies within Fort Richardson.

2.2.4.1.3 Salt Water

Roughly 12 miles of shoreline along the Knik Arm of Cook Inlet form the northern border of Fort Richardson. Eagle Bay is located in the southern portion of this area, where Knik Arm merges with the Eagle River. Tidal activity in Eagle Bay has created an estuarine salt marsh encompassing ERF impact area. Numerous ponds dot the marsh. Many of these are shallow mudflat ponds, less than 6 inches deep that often dry up during summer. Others are more permanent and achieve depths of over 4 feet. These deeper ponds often are fed by freshwater streams and springs.

In 1994, a comprehensive evaluation of ERF was conducted to address water quality of these ponds (CH2M Hill, 1994b). The salinity level varied from 1 to 46 parts per thousand (ppt). Salinity in most ponds was below 10 ppt. Tidal flooding of ERF infuses ponds with saltwater and sediments from Eagle Bay. Elevation determines frequency of floods, varying from mean sea level (msl) to 18 feet above msl. Flooding may occur daily during high tides in areas less than 12 feet above msl. In areas from 12 feet to 13 feet above msl, flooding occurs only with the highest tide each month, and in areas above 13 feet, flooding occurs only during extremely high tides (CH2M Hill, 1994).

2.2.4.2 Ground Water

Two freshwater aquifers underlie most of Fort Richardson. These aquifers flow west from the Chugach Mountains to the Cook Inlet and are recharged by groundwater originating from precipitation in the mountains. The two aquifers lie in different soil strata, and are separated by a 60 to 200-foot layer of impermeable Bootlegger Cove Clay. The upper, unconfined aquifer lies in a 30 to 100-foot layer of well-bedded and well-sorted gravel near the surface. This aquifer usually can be accessed at depths of less than 50 feet (CH2M Hill, 1994b).

The lower, confined aquifer lies in a 100 to 200 foot-layer of sand and gravel. The impermeable clay above produces artesian conditions and protects the lower aquifer against seepage and pollutants from the surface, thus the water quality of this artesian aquifer is excellent. It is estimated that 75 million gallons of water originating from the mountains recharges the aquifer each day. This aquifer usually can be accessed from 200 feet to 400 feet below the surface. Wells drilled into the aquifer can produce up to 1,500 gallons of water per minute (CH2M Hill, 1994b).

Industrial activities associated with Army occupation on Fort Richardson have had some minor effects on groundwater. These effects are associated with underground storage tanks, facilities where chemicals were stored, and places where chemicals were dumped. These areas are now being monitored intensively, and there has been no indication of deep groundwater pollution. Pollution has been minor, localized, and there has been no significant risk to human health. Recently, water quality has tended to improve as Army restoration projects mitigate earlier damage to the quality of groundwater.

2.2.5 Climate

By Alaskan standards, the Anchorage area has a moderate climate. Fort Richardson is in a transition zone between the northern continental climate of the Alaskan interior and the maritime climate of the Gulf of Alaska. The Alaska Range to the north and northwest of the post acts as a barrier to very cold air from the interior. The Kenai and Chugach Mountains to the south and east prevent the influx of maritime air from the Gulf of Alaska. The waters of the Cook Inlet and the Knik Arm serve to moderate temperatures and provide moisture (Elmendorf AFB, 1994).

Fort Richardson has a long winter with subfreezing temperatures that usually lasts from mid-October to mid-April (see Table 2-1). High pressure weather systems during this period may lead to successive days with temperatures below minus 35 degrees Fahrenheit (F). The spring is marked by the ice “break-up” starting in mid-April, and lasting until June, characterized by a rapid rise in temperature. Summer lasts from June to early September, and has a daily average temperature of 56 degrees F. Autumn on Fort Richardson is brief, lasting from about mid-September to mid-October.

According to a number of scientists, the effects of global warming are already taking a toll in Alaska. Damage to forests, loss of salmon habitat and widespread melting of permafrost are being attributed to a permanent and significant climate regime shift. Major changes in temperature, warming of rivers and extensive melting of permafrost have been clearly evidenced in both Alaska and Canada over the last 20 years.

Tree growth studies conducted by University of Alaska Professor, Glenn Juday, have found clear indication that normal cycles of forest growth changed dramatically starting in the early to mid 1970s. The studies also show that the forests have been experiencing stresses since then, often involving complex interactions of different effects of warming that have no precedent in the historical record. This could eventually lead to the boreal forest dying out and being replaced with grassland steppe vegetation that covered much of interior Alaska in the Pleistocene period ten thousand years ago. Melting of permafrost creates sinkholes and differential settling of the ground which damages roads, building foundations, airports, and other man-made structures. Significant amounts of salmon spawning habitat may be lost due to stream warming.

Although thermokarst (melting of permafrost) is not a major problem in most parts of southcentral Alaska due to only small isolated areas being underlain with permafrost, spruce bark beetle (*Dendroctonus rufipennis* [Kirby]) infestations have reached epidemic proportions during the 1990s. Warmer than average summers and other climatic conditions as well as large tracks of mature, even-aged, and unhealthy spruce forests have contributed to the beetle outbreak. Activity levels in southcentral Alaska have increased to nearly a million acres of active infestation (Dr. Edward Holsten, pers. com.). The damage is resulting in the catastrophic long-term loss of 60–80 percent of spruce trees larger than 9 inches in diameter. The infestations reduce forest diversity and increase fuel loading, which substantially increases forest fire danger in the affected areas.

Soils on Fort Richardson are subject to seasonal freezing. The average last date for a killing frost is May 15, and the average first date for a killing frost is September 8, providing a 115-day growing season (Elmendorf AFB, 1994). Average monthly temperatures for the Anchorage area are provided in Table 2-1. Permafrost on Fort Richardson is all but absent, probably occurring only as remnants from the last Ice Age, deep within peat deposits.

Prevailing winds come from the west in summer and from the north and northeast in winter. Average wind velocity is six miles per hour (mph). Channeling of south and southeasterly winds passing over the Chugach Mountains, during low pressure systems called “chinooks”, can lead to wind gusts up to 100 mph. These gusts can inflict significant property damage (Gossweiler, 1984).

Approximately 40 percent of the 15-inch annual precipitation falls from mid-July to mid-September (Gossweiler, 1984). The six months of winter account for another 40 percent of annual precipitation with an average of 72 inches of snowfall. Spring and autumn combine for a meager 3 inches of the annual precipitation (Elmendorf AFB, 1994).

Table 2-1. Average Temperatures (Degrees Fahrenheit) by Month, March 1941-December 1991 for the Fort Richardson Area (Elmendorf AFB, 1994).

Month	Average		Mean	Extremes	
	High	Low		Maximum	Minimum
January	19	5	12	49	-38
February	25	10	18	58	-33
March	32	15	24	51	-24
April	43	28	35	65	-20
May	54	39	47	80	12
June	62	47	55	86	33
July	65	51	58	83	35
August	63	49	57	82	29
September	55	42	49	74	20
October	41	29	35	63	-6
November	27	15	21	57	-20

December	19	7	13	53	-34
Annual	42	26	35		

2.3 Biological Resources

2.3.1 Biodiversity

Biodiversity is difficult to quantitatively track with the exception of game species and a few other species of high interest. Although the land was degraded when the Army moved onto Fort Richardson, the extent of that degradation and associated damage to the biodiversity is unknown. Army occupation probably improved overall forest ecosystem biodiversity as timber was allowed to age with the exception of areas in the lowlands that were damaged and set back successionally.

It is difficult to determine whether the military mission has significantly affected biodiversity. Changes in ecosystems were in all likelihood very localized, and may have affected species abundance for relatively short periods, but probably did not affect overall species richness. This is particularly true when Fort Richardson is compared with other surrounding lowland areas. These areas were developed, and biological diversity was decreased significantly, a fate that probably would have happened to much of Fort Richardson's lands had they not been occupied by the Army.

Due to a lack of historical data on the flora and fauna of Fort Richardson, the discussion above is largely speculative. Implementation of this INRMP will improve the capability of the Army to monitor biodiversity trends in future years.

2.3.2 Flora

"*I do not believe we could survive without the rest of nature; but most important, what good will it be if we live to inherit a barren world devoid of natural things –the wild things that make life worth living.*"[1]

2.3.2.1 Vegetative Profile

G. Tande, Alaska Natural Heritage Program, prepared an appendix, *Vegetation of Fort Richardson*, for the floristic inventory of the post (Lichvar et al., 1997). The following is excerpted from that appendix.

Fort Richardson falls within the Cook Inlet Lowlands Section of the Coastal Trough Humid Taiga Province of Bailey's Ecoregions of the United States (McNab et al., 1994). Forests in the Anchorage area closely resemble the Boreal Forest of Interior Alaska, although some understory and tree species occur that are typically found in the Coastal Spruce-Hemlock Forest. Fort Richardson's forests have been described as open, low-growing spruce and closed spruce-hardwood forests by Viereck and Little (1972), and as a lowland spruce-hardwood forest by the Joint Federal-State Land Use Planning Commission (JFSLUP, 1973). Packee (1994), in examining Alaska's forest vegetation zones, characterizes the region as an area where white spruce *(Picea glauca)* and Sitka spruce (*Picea sitchensis*) naturally hybridize; balsam poplar (*Populus balsamifera*) and black cottonwood *(Populus trichocarpa)* intergrade; and mountain hemlock *(Tsuga mertensiana)* may form the subalpine forest. Vegetation reflects the

[1] Sir Peter Scott.

transitional nature of the climate between maritime and continental. This maritime climatic influence has resulted in a lower incidence of natural fire than is found in the spruce-hardwood forests of interior Alaska (Gabriel and Tande, 1983).

Upland sites on Fort Richardson are dominated by paper birch (*Betula paperifera*), white spruce, and, on drier sites, quaking aspen *(Populus tremuloides*). Cottonwood and poplar are common in areas bordering principal streams. Black spruce *(Picea mariana*) is the dominant tree in wetter areas and on some well-drained sites. Most bogs are treeless or support stands of stunted black spruce. Grasses, herbs, willows (*Salix* spp.), and alders (*Alnus* spp.) dominate the vegetation in a narrow band along the Inlet and at elevations above 1,500 feet on the Chugach Mountain slopes.

White spruce, mountain hemlock, and, to a lesser extent, balsam poplar, are the dominant treeline species in southcentral Alaska (Viereck et al., 1992). At upper elevations, graminoid forb meadows, alder, and dwarf birch (*Betula glandulosa/nana*) thickets give way to low-growing alpine vegetation in the Chugach Mountains.

Fort Richardson Military Reservation is a topographically diverse area varying from mudflats inundated by the tides of Cook Inlet to mountain peaks of over 5,300 feet. Many different vegetation communities are represented, from coastal salt marsh and boreal forest types to high alpine tundra, talus slopes, shrublands, snowbeds, heaths, and meadows. The following five zones of vegetation and plant habitats were recognized for the purposes of the floristic inventory:

- **COASTAL HALOPHYTIC ZONE** influenced by salt water, principally including shoreline tidal flats and the 2,137-acre ERF estuarine marsh on Cook Inlet.

- **LOWLAND INTERIOR FOREST ZONE** of boreal forest habitats below approximately 1,500 feet. Mesic to dry forest types include: white spruce; white spruce-paper birch; paper birch, white spruce-cottonwood, black cotton-wood-balsam poplar, and quaking aspen. Wetlands are predominantly black spruce tree bogs and treeless bogs with a variety of low shrub and graminoid forb communities. Alder shrub is a dominant type of the Lowland Interior Forest Zone.

- **SUBALPINE ZONE** of intermittent forest, shrub, and meadow habitats from approximately 1,500 feet to 2,500 feet elevation. Mesic to dry sites include white spruce, white spruce-paper birch, balsam poplar, and mountain hemlock. Forests are interspersed with alder shrub and grass forb meadows. Treeless bogs are occasionally present in the Subalpine Zone.

- **ALPINE ZONE** of mountain landscape habitats above treeline. Low shrubs and dwarf shrubs occupy wet and mesic to dry habitats. The latter include mesic to dry vegetated sites and dry non-vegetated sites such as rock talus and blockfields. Wetter habitats include late-melting snowfields and snowbeds.

- **ARTIFICIALLY CLEARED OR DISTURBED ZONE** of the cantonment area, utility corridors, roadsides, railroad right-of-ways, borrow pits, wood cutting areas, moose habitat areas, small arms ranges, firing points, landing zones, and other human-modified areas.

2.3.2.2 Floristic Inventory

A comprehensive floristic inventory of Fort Richardson was conducted in 1994 (Lichvar et al., 1997). The inventory included vascular plants, ferns and fern allies, the more common mosses, liverworts, and lichens. The University of Alaska, Fairbanks, assisted with the lichens, mosses, and liverworts. Fort Richardson has one set of archival herbarium mounts and one set of specimens laminated in plastic for use during fieldwork.

Plants were collected from six areas at 98 collecting sites. A total of 1,087 vascular plant collections were made. The inventory found 561 vascular species (588 taxa including subspecies and varieties), in 75 families and 246 genera. At least 75 species collected represented extensions in known ranges. Fort Richardson has about 30 percent of Alaska's vascular flora (Lichvar et al., 1997).

A total of 986 collections were made of cryptogams. The inventory found 239 species (256 taxa including subspecies and varieties), which represented 19 hepatics, 112 lichens, and 108 mosses (Lichvar et al., 1997).

Elmendorf AFB (1994) lists vascular plants, mosses, and lichens found on the base during the 1982–1983 Resources Inventory. This list is generally applicable to Fort Richardson.

2.3.2.3 Threatened or Endangered, and Species-of-Concern Plants

A comprehensive survey of rare plants was included as part of the floristic inventory for Fort Richardson conducted in 1994. Only two plant species on the federal endangered species are known to occur in Alaska. Neither species' current or historic ranges include Fort Richardson, and a report released in 1995, indicated that there are no federally listed endangered or threatened plant species on Fort Richardson (Lichvar et al., 1997). There is, however, one former category 2 candidate species, *Taraxacum carneocoloratum*, found in alpine areas of the Chugach Mountains. This plant has been discovered at an increasing number of sites in Alaska, and its candidate status may be reevaluated.

There are also 22 vascular vascular plant species-of-concern that are known to occur on Fort Richardson. These plants are being tracked by the Alaska Natural Heritage Program because they are thought to be uncommon or rare in Alaska and/or uncommon or rare globally (Alaska Natural Heritage Program, 2000). These species are listed below in Table 2-2 and are documented in the survey results of Lichvar et al. (1997). Many of these plants are alpine natives and this ecosystem is also the most vulnerable to the effects of military training. There are no legal ramifications from these listings; rather they are generated by the Heritage Program to help track the occurrence of these taxa across the state as more botanical work is conducted. The categories listed do not indicate known threats to these species, but they do represent the rather few collections known for each taxa in Alaska and the geographic distribution of those collections. All of these taxa are listed for management in the ecosystem management program for Fort Richardson (see Chapter 3).

Table 2-2. Rare Plant Species Occurring on Fort Richardson.

SPECIES	ALASKA NATURAL HERITAGE PROGRAM RANKINGS	
	GLOBAL	STATE
Aphragmus eschscholtzianus	rare or uncommon	rare or uncommon
Arnica ovata	demonstrably secure	critically imperiled
Carex deweyana	demonstrably secure	unranked or critically imperiled
Cassiope lycopodioides ssp. cristapilosa	cause for concern/demonstrably secure	critically imperiled

SPECIES	ALASKA NATURAL HERITAGE PROGRAM RANKINGS	
	GLOBAL	STATE
Douglasia alaskana	imperiled/rare or uncommon	imperiled/rare or uncommon
Draba ruaxes	rare or uncommon	rare or uncommon
Eleocharis kamtschatica	cause for concern	imperiled
Eleocharis quinqueflora	demonstrably secure	critically imperiled
Eriophorum viridi-carinatum	demonstrably secure	imperiled
Glyceria striata ssp. stricta	demonstrably secure	imperiled
Minuartia biflora	demonstrably secure	imperiled
Myriophyllum verticillatum	demonstrably secure	rare or uncommon
Najas flexilis	demonstrably secure	critically imperiled/imperiled
Oxytropis huddelsonii	rare or uncommon	imperiled/rare or uncommon
Papaver alboroseum	rare or uncommon/cause for concern	rare or uncommon
Phalaris arundinacea	demonstrably secure	rare or uncommon
Saxifraga adscendens ssp. oregonensis	cause for concern/demonstrably secure	imperiled/rare or uncommon
Stellaria umbellata	demonstrably secure	imperiled/rare or uncommon
Taraxacum carneocoloratum	rare or uncommon	rare or uncommon
Thlaspi arcticum	rare or uncommon	rare or uncommon
Viola selkirkii	demonstrably secure	rare or uncommon
Zannichellia palustris	demonstrably secure	rare or uncommon

2.3.2.4 Vegetation Mapping

CEMML-CSU initiated vegetation mapping on Fort Richardson in 1995. Mapping was done in two phases: remote sensing and ground truthing. Color aerial photos of the post taken in 1995, and other aerial imagery, were used to identify types and delineate clusters of vegetation. LCTA data was used to verify vegetation types on the ground. Finally, extensive ground truthing was completed in areas not covered by LCTA data. With the exception of detailed evaluations of ERF in 1993–1994 (Racine, et al., 1993; CH2M Hill, 1994b) and a general forest cover type survey conducted in 1955 (Quirk, 1990), no other maps illustrating vegetation cover on Fort Richardson have been produced. The vegetation map was completed in 1998 (Figure 2-7).

2.3.2.5 Wetland

On Fort Richardson, there are freshwater and saltwater marshes, bogs, lakes and lake margins, and riparian areas. These wetlands may or may not qualify as jurisdictional wetlands (i.e. as defined in Section 404 of the Clean Water Act). Jurisdictional wetlands are determined by the Corps of Engineers on the basis of hydric soils, aquatic vegetation, and hydrology.

The post has estuarine, palustrine, riverine, marine, and lacustrine wetlands. Within ERF Impact Area, there are 2,165 acres of wetlands. Wetlands on Fort Ricahrdson are shown in Figure 2-8.

National Wetlands Inventory (NWI) mapping was completed for the post using 1978 aerial photographs. The NWI maps, however, were determined to be inadequate for meeting the present needs of Fort Richardson. As a result, in the summer of 1995, WES completed an intensive field survey to revise the NWI maps of the post (Lichvar and Specher, 1996). These revised wetland maps provide greater accuracy in delineation of wetlands on Fort Richardson and are also useful to the Alaska District, Corps of Engineers for jurisdictional wetland determination.

WES is classifying wetlands on Fort Richardson based on values, functions and size. Classification was used to develop a Wetlands Management Action Plan.

2.3.2.6 Forest Resources

In 1955, a mapping of forest types was completed that still serves as the primary indicator of forest composition (Henley et al., 1955). Forest types are comprised of stands with similar composition and development. The eight forest types on the post are listed below.

- **White Spruce Type:** This type is distinguished by the occurrence of at least 70 percent white spruce. Pure stands of white spruce represent the "climax" or mature stage of forests at Fort Richardson on suitable sites. White Spruce Type is found on relatively dry, level, and well-drained soils. Spruces associated with this type usually occur as even-aged, old growth trees.

- **Paper Birch Type:** This common type is characterized by a predominance of paper birch. Birch is often the primary tree species to invade disturbed sites, and therefore represents a transitional stage in the development of white spruce forests. Stands are typically even-aged, and occur on well-drained, level to sloping sites where there has been ground disturbance.

- **Quaking Aspen Type:** This type is characterized by pure even-aged stands of quaking aspen. The stands occur on warm, dry, south- facing slopes. This type is uncommon on Fort Richardson.

- **Cottonwood and Balsam Poplar Type:** This type is characterized by a predominance of black cottonwood and/or balsam poplar. It occurs on poorly drained soils in flood plains along streams and certain upland areas. It may occur as an early stage in development of white spruce forests.

- **Black Spruce Type:** Stands of this type usually consist of only black spruce. They occur on cold, poorly drained soils with little productive potential. On Fort Richardson, they are commonly adjacent to bogs.

- **Mixed Spruce-Hardwood Type:** This is the most common forest type on the post, characterized by mixed stands of white spruce, paper birch, quaking aspen, and balsam poplar. It occurs on well-drained, level to sloping sites.

- **Brush Type:** This type is characteristic of non-forest ecosystems, such as shrub thickets and sub-alpine areas. It is dominated by stunted and/or sapling willows (*Salix* spp.), alders (*Alnus crispa, A. sinuata, A. tenuifolea*), and paper birch.

There are no significant markets for forest products found on the post at this time. On neighboring Elmendorf AFB, 47 percent of the timber stands are over 175 years old, 30 percent are 50-100 years old (due to fires in the first third of this century), and 23 percent are less than 50 years old (due primarily to military-related losses). No stands are between 100 and 175 years old (Elmendorf AFB, 1994). Much of the older age timber is in "an advanced state of decline" (Elmendorf AFB, 1994), and there is obvious damage from spruce bark beetles *(Dendroctonus rufipennis* (Kirby)) in older stands on Fort Richardson. It would take very intensive timber stand improvement and a considerable amount of time for regrowth to create a significant commercial forest on the post. There is little justification for this course of action at present.

2.3.3 Fauna

"*What is man without the beasts? If all the beasts were gone, man would die from a great loneliness of spirit. For whatever happens to the beasts soon happens to man.*"[2]

Due to diverse ecosystems and a relatively unobtrusive military mission, most species indigenous to southcentral Alaska can be found on Fort Richardson. Two important wildlife components on the post are a highly productive moose population that has responded well to adequate habitat and specialized management practices, and a concentration of waterfowl attracted to the tidewater saltmarsh. A list of verified species is provided in Appendix F. Wildlife habitat is shown in Figure 2-9.

2.3.3.1 Mammals

Moose: Moose (*Alces alces*) is a key species for wildlife management on Fort Richardson. They are the largest, most abundant, and most sought-after species among hunters and wildlife viewers (Gossweiler, 1984; Bennett, 1982). Managing for moose will also benefit a variety of other wildlife species that share the same environmental conditions and variables.

A survey of the Fort Richardson moose herd is conducted annually using fixed-wing aircraft. This survey is usually flown in November, by the ADF&G and DPW Environmental Resources Department.

Over the past twenty years, the moose population that frequents Fort Richardson, Elmendorf AFB, and Ship Creek (hereinafter referred to as the Fort Richardson moose herd) has remained relatively stable at a projected population of 525 to 650 animals (Quirk, 1996). The nine-year average (1986–1994) calf:cow ratio was 39:100, and the bull:cow ratio was 48:100. The average number of bulls per 100 cows is substantially higher than normal due to the desire to maintain a greater number of bulls for urban viewing and photography. The average number of calves per 100 cows is at the high end of normal for moose herds throughout Alaska. Exceptionally high calf production occurred in 1986 and 1987 (58-60:100) with calf production in the 28-38:100 range during 1988–1994.

Although the Fort Richardson moose herd has been relatively stable over the years, there have been some sporadic declines during extreme winters with persistent and deep snow packs. Only one winter (1994–1995) with unusually heavy and persistent snowfall resulted in a large decrease in the moose population (26 percent). ADF&G believes that overbrowsing, associated with a herd above carrying capacity in the Anchorage area (including Fort Richardson), was the cause of the loss. Compounding the issues has been the steady and significant loss of moose habitat on Fort Richardson due to construction, drop zone enlargement, and land transfers. This loss of hundreds of acres has reduced the overall carrying capacity for moose. Additionally, heavy snows during the 1994–95 winter further exacerbated the situation.

[2] Chief Seattle 1854.

During the past five years, annual hunter harvest of moose has averaged 40–45 animals per year. Table 2-2 shows results of moose survey data from 1986 through 1996.

Table 2-2. Annual Moose Population, 1986 - 1996.*

Year	Total	Cows	Calves	Bulls	Bulls/ 100 Cows	Calves/ 100 Cows
1986	474	230	137	107	47	60
1987	398	173	100	125	72	58
1988	455	256	80	119	46	31
1989	476	264	97	115	44	37
1990	339	172	60	107	62	35
1991	490	282	105	103	36	37
1992	355	214	67	74	35	31
1993	456	256	78	122	48	38
1994	401	239	67	95	40	28
1996	294	157	48	89	56	31
Avg.	413.8	224.3	83.9	105.6	48.6	38.6

The size of Fort Richardson's herd makes it the largest concentration of wintering moose in the Anchorage urban area. The long-term vitality of the herd is due, in part, to wildlife management practices by Fort Richardson and ADF&G since the mid-1960s. Fort Richardson has had limited success in improving moose browse and clearing and rehabilitating areas for preferred plant species. Likewise, ADF&G has taken great interest in promoting the population and improving recreational value of moose for the Anchorage area. USARAK and ADF&G manage moose cooperatively in accordance with a 1992 cooperative agreement drafted solely for the purpose of conserving the moose population. During recent discussions between USARAK and ADF&G personnel, the fall population objective of 600 moose was reduced to 500 to minimize the potential for a high rate of mortality due to over-browsing. Moose habitat preferences are shown in Figure 2-10.

Other Big Game Species: Other big game species occur on the post but are not hunted. These include grizzly bear *(Ursus arctos*), black bear *(Ursus americanus*), and Dall sheep *(Ovis dalli*) (Quirk, 1994).

Small Game and Furbearers: Small game and furbearers found on Fort Richardson include coyote (*Canis latrans*), wolf (*Canis lupus)*, lynx (*Lynx canadensis*), red squirrel (*Tamiasciurus hudsonicus*), snowshoe hare (*Lepus americanus*), hoary marmot (*Marmota caligata*), marten (*Martes americana*), beaver (*Castor canadensis*), river otter (*Lutra canadensis*), wolverine (*Gulo gulo*), red fox (*Vulpes*

vulpes), porcupine (*Erethizon dorsatum*), and mink (*Mustela vison*), Game species are included in Appendix F.

Cook and Seaton (1995) have prepared a Checklist of the *Mammals of Fort Richardson, Alaska,* which includes both confirmed and suspected species. The first post-wide small mammal survey was conducted in summer 1994 by the University of Alaska Museum. This survey used LCTA field plot locations as sampling locations. Results of the survey are included with the list of mammals currently known to occur on the post in Appendix F.

2.3.3.2 Birds

Several bird surveys on Fort Richardson have been conducted in recent years. Together, they provide a reasonably complete inventory of the species that use the post. A 1994 USFWS raptor inventory on Fort Richardson (Schempf, 1995) discovered six different types of raptors: bald eagle, golden eagle, northern harrier, red-tailed hawk, Harlan's hawk (dark phase of red-tailed hawk), and sharp-shinned hawk. Although no goshawks were found during this inventory, they are known to inhabit the dense forested areas of the post.

Game species include spruce grouse *(Dendragapus canadensis*), ptarmigan (*Lagopus spp.*), and numerous ducks and geese.

An intensive owl survey conducted by the USFWS in 1997 (Browne and Andres, 1998) identified three species: great-horned, saw-whet, and boreal.

Since 1994, an ongoing inventory and monitoring of landbirds has been conducted in conjunction with LCTA, and the USFWS has also been assisting USARAK with bird surveys. This project adopts study methods endorsed by Partners in Flight and has the following goals: identifying avian habitats, conducting a breeding bird survey, establishing certain intensive study sites for neotropical birds modeled after Monitoring Avian Productivity and Survivorship (MAPS) stations, and compiling an post-wide bird checklist (Roush and Andres, 1994). A total of 40 bird plots have been established in conjunction with LCTA, and two MAPS stations are currently being manned (Andres, 1994). A progress report (Roush and Andres, 1994) based on 341 hours of observation recorded 55 species.

Waterfowl and other birds associated with the ERF wetlands have been the most thoroughly documented avian species on the post. Inventories associated with intensive evaluations of ERF (CH2M Hill, 1994b; Racine, et al., 1993) have identified 75 avian species, including 24 species of waterfowl, occurring in the tidal salt marsh. These studies also provided crucial information on avian habitat and behavior. Every field season, since 1990, USARAK has conducted ground and aerial surveys of birds occurring in ERF, McVeigh Marsh, and post ponds and lakes (Fort Richardson, 1994). These surveys are usually done from fixed-wing aircraft and focus particularly on determining the size of waterfowl populations (Quirk, 1994). Refer to Appendix F for complete list of bird species found on Fort Richardson.

2.3.3.3 Fish

Ten species of fish are found in post lakes and waterways. Fort Richardson is part of the Anchorage Area Management Unit for fisheries administered by the ADF&G. The ADF&G periodically stocks rainbow trout *(Oncorhynchus mykiss*, landlocked salmon *(Oncorhynchus* spp.), Arctic grayling (*Thymallus arcticus*), and arctic char (*Salvelinus alpinus*) in the five managed lakes (ADF&G, 1995) and maintains records of fish harvested from post streams and rivers. Species of game fish occurring in these waterways include silver salmon (*Oncorhynchus kisutch*), king salmon (*Oncorhynchus tshawytsha*), red salmon (*Oncorhynchus nerka*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), and

Dolly Varden *(Salvelinus malma*). Fort Richardson's only significant non-game fish are the three-spine stickleback (*Gasterosteus aculeatus*) and the slimy sculpin (*Cottus cognatus*). One other species recorded on Elmendorf AFB, and probably found on Fort Richardson, is the nine-spine stickleback (*Pungitius pungitius*) (Roth, et al., 1983).

Gill-netting has been conducted occasionally in the five managed lakes to monitor fish populations since 1975 (Bennett, 1982). Although these fish surveys are scheduled semi-annually for spring and fall, whether or not they are done is determined by the availability of personnel. The primary method for monitoring fish in rivers and streams is the annual angler harvest. A list of fish species known to occur on Fort Richardson is included in Appendix 8-2.

2.3.3.4 Reptiles and Amphibians

No reptiles are known to occur on Fort Richardson. One species of amphibian, the wood frog (*Rana sylvatica*) is found on the post. The frog is common in bogs, freshwater and saltwater marshes, and lake margins. In ERF, it is an important prey species for migrating sandhill cranes (CH2M Hill, 1994b).

2.3.3.5 Special Status Fauna

No federally listed endangered animals inhabit Fort Richardson. A threatened species, the American peregrine falcon (*Falco peregrinus*), is known to pass through the area. Though not found during the recent raptor inventory (Schempf, 1995), it was recorded during field studies at ERF in May and August 1991–1992 (CH2M Hill, 1994b).

A federally listed threatened species, the bald eagle (Haliaeetus leucocephalus), is common locally. Although its threatened status does not apply in Alaska, it is afforded special protection by USARAK in accordance with the Bald Eagle Protection Act (Quirk et al., 1978). In the raptor inventory (Schempf, 1995), bald eagles were the most frequently seen species.

Two other avian species, the trumpeter swan *(Cygnus buccinator*) and the golden eagle (*Aquila chrysaetos*), are of special concern for wildlife management on Fort Richardson. As the world's largest waterfowl species, the trumpeter swan is a migrant on Fort Richardson, stopping in ERF during both spring and fall migrations. The golden eagle is a resident of the alpine habitats of the post. (Quirk et al., 1978).

Within recent years, beluga whales (*Delphinapterus leucas*) have been sighted within ERF as far as 1¼ miles up the Eagle River. They have been observed chasing salmon up drainages along the river bank (Quirk, 1994). These, as well as all whales in United States waters, are protected under the Marine Mammals Act.

2.3.4 Special Interest Management Areas

"Biologically or geographically significant or sensitive natural resources . . . shall be inventoried and managed to protect these resources, and to promote biodiversity . . ."[3]

Designation of special protection status for important or fragile natural areas is an effective management tool. In accordance with AR 200-3, areas that contain natural resources that warrant special conservation efforts will be identified during the inventory and classification process. After appropriate study and coordination, such areas may be managed as "Special Interest Areas" for their unique features. Per AR

[3] DOD Instruction 4715.3, Environmental Conservation Program.

200-3, this INRMP “will address the special management necessary for these areas, and all current and future land-uses will consider the uniqueness of these areas and plan accordingly to ensure conservation of their resources”.

Fort Richardson has areas with special natural features. They harbor sensitive or unique wildlife species, represent unique plant communities, or possess unusual geologic or topographical characteristics. The following is a description of the currently identified special interest areas on Fort Richardson along with restrictions and stipulations for their use. Special interest areas on Fort Richardson are shown in Figure 2-11.

2.3.4.1 Old-Growth Forest

Old-growth forests are defined as ecosystems dominated by old trees and related structural features that are characteristic of later stages of successional development. They differ from earlier stages in structure, composition, and function (Kaufmann et al., 1992). In the Pacific Northwest, where most old-growth research and public attention has been focused, six attributes have been used to characterize old-growth forests: large trees; snags; large down woody material; multiple tree canopy layers; associated shrub, herb, and grass components; and canopy gaps (USDA Forest Service, 1992). Old- growth attributes such as multiple canopy layers, large accumulations of dead and down trees, and multiple species are not found in all types of old-growth forests and can be found in earlier stages of successional development (Kaufmann et al., 1992). Sites that do not have a full complement of old-forest characteristics can partially function as old forests for those attributes that are present. Viereck et al. (1992) pointed out that old-growth is not synonymous with old age and must be recognized on the basis of stand characteristics.

Primary tree species that compose old-growth on Fort Richardson are paper birch and white spruce. Birch is relatively short-lived (80–120 years), while white spruce is relatively long-lived (over 250 years). White spruce/paper birch is a recognized forest cover type in southcentral Alaska, but it is considered to be a transitional stage that follows paper birch and precedes the white spruce type (Eyre, 1980). Thus, old-growth in this region is very different from the Douglas fir/Sitka spruce/western hemlock forests of the Pacific Northwest and southeastern Alaska, which can attain ages of 500–700 years or more. For the purposes of this plan, old-growth on the post is tentatively defined as stands with the dominant trees being 150 to 200 years old. Trees of this age are rare on Fort Richardson due to fires that burned over much of the area in the 1920s and ‘30s. The spruce bark beetle has decimated much of the older spruce forest on the post as well.

Most of the old-growth forest type on Fort Richardson was thought to occur near Otter Lake, but other than that little was known of it. In 1995, a study was initiated to identify and characterize old-growth on the post. Results of the study will be used to determine management strategies that will be based on the total acreage identified as old-growth and will likely emphasize some degree of protection for these stands. It will be important to manage the entire forest ecosystem so that some older stands are allowed to mature into old-growth over time.

High-quality groves of old-growth will be ideal for inclusion in the Watchable Wildlife program on Fort Richardson. Such special areas will be marked for protection from damage and identified in brochures indicating special places to visit on post (when compatible with troop training activities).

2.3.4.2 Krummholz

Beyond treeline, species usually considered as trees are so stunted that they are more like shrubs. These stunted trees are called krummholz, a descriptive German word meaning “elfin timber” or “crooked wood”.[23] Krummholz growth habit is shrubby and dense, becoming more prostate, twisted and contorted with altitude. Treetops are flat or flagged or both; trunks are gnarled. Basal branches form impenetrable masses of long intertwined serpentines, impossible to walk through.

Any of the evergreen tree species of the subalpine forest may be represented in the krummholz. Since krummholz trees rarely produce seed, most seedlings sprout from seeds blown up from lower altitudes. They then become established in pockets of the subalpine regions that provide suitable microhabitats. Propagation of this unique vegetative community is most commonly carried out by "layering", the rooting of tree branches that come in contact with the soil. The erratic topiary shapes of krummholz represent the outer boundaries of a favorable microclimate that is circumscribed by cold temperatures and abrasive drying winds. Only the part of the krummholz covered by the snowpack escapes winter damage.

Single krummholz trees are stunted and seldom exceed six to eight feet in height. Many of these trees are flagged; the top branches pruned back by the desiccating effect of winter wind. Only the leeward branches remain on the trunk, semi-protected by its mass, looking like arboreal wind socks. The age varies; some krummholz trees in Rocky Mountain National Park have been cored out to be over 300 years. The oldest tree was 390 years of age. When krummholz does become established, it dominates the microhabitat, out-competing many other subalpine plants. Many tundra creatures shelter near the krummholz, and many lower altitude plants are able to extend upward within its protection.

Fort Richardson has classic examples of krummholz vegetation communities in the subalpine regions. Infantry Flats is accessible by an all-weather road and a trail leads through the krummholz patches of evergreens. The dominant krummholz evergreen in the subalpine zone is mountain hemlock (Tsuga mertensiana). It grows in large patches of an acre or more in forest groves beyond the upper limits of the boreal forest. These groves may attain a height of 15 feet. Other krummholz evergreens are white spruce trees that grow as single trees; the top branches often flagged. One other evergreen species found growing in the subalpine region is juniper (Juniperus communis), which attains a height of about three feet. The juniper does not appear to be stunted nor is it twisted and gnarled.

2.3.4.3 Alpine Tundra

Alpine tundra is the most extensive, ecologically sensitive area on Fort Richardson. The area is shown on the vegetative map (see Figure 2-7). The major restriction imposed on this area is the prohibition of vehicular traffic off roads and trails indicated on the training map.

2.3.4.4 Cultural Resource Areas

USARAK takes special measures to protect its cultural resources. An Integrated Cultural Resources Management Plan for Fort Richardson has been developed under separate cover. This plan will provide guidance for the inventory and evaluation of historic buildings and archaeological resources.

2.3.4.5 Ship Creek Riparian Area

Ship Creek and its riparian habitat are important and sensitive areas on Fort Richardson, requiring protection to insure maintenance of its health and natural function. Water quality on Ship Creek is of utmost importance because any deterioration on Army lands will affect downstream locations on Elmendorf AFB and in the City of Anchorage. USARAK's goal is to maintain Ship Creek in a condition as pristine as possible and to repair portions that may become damaged. Further development, beyond that already approved for the golf course expansion, will not occur in the riparian area. Tree cutting will be prohibited. Clearing for the golf course will be limited to that absolutely necessary for course construction. Troops and other authorized users will continue to have "pass through" access.

2.3.4.6 Eagle River Corridor

Approximately 8 miles of the glacial fed Eagle River pass through Fort Richardson. The river, characterized by a swift cold current with high sediment loads, supports native runs of all five species of Alaskan salmon. It is important for both military training and recreational activities. The river corridor on Fort Richardson varies between steep bluffs and low lying wetlands. Besides Ship Creek, it is the only area on the installation with a substantial riparian ecosystem. It is USARAK's goal to maintain this corridor in a natural condition with the exception of some periodic construction activities at two bridge crossing sites.

2.3.4.7 Other Riparian Areas

There are other small riparian areas on Fort Richardson that require special protection. These areas include Fossil Creek and Clunie Creek. These areas are being identified, and they will be protected as required. Limitations on military training and recreational activities provide some measures that protect riparian ecosystems.

2.3.4.8 Lakes

Major lakes are important to ecosystem integrity and outdoor recreation on Fort Richardson. Often, older forests are associated with these lakes. There are certain military activities that can occur on or near these lakes without significant damage to either natural processes or outdoor recreation opportunities. Section 6.2.4 describes the special considerations associated with these lakes and other recreational areas. All military activities planned for these lakes and their immediate surroundings will require approval from the Natural Resources Branch prior to implementation. Vehicular maneuvers or intensive bivouac operations will not be permitted in these areas without such approval. Dog training is prohibited at Fort Richardson's lakes, with the exception of Thompson Lake, Derby Pond, and Dishno Pond.

Some lakes are losing their pristine quality (e.g. Waldon Lake) due to abuse from users. The establishment of quality roads, parking areas, barricades, and trails will significantly improve the ability of natural resource managers to control the distribution of use.

2.3.4.9 Eagle River Flats

ERF is an important 2,136-acre coastal halophytic salt marsh on the Knik Arm of upper Cook Inlet and the post's premier wetland. Lower Eagle River bisects the marsh. The marsh and associated shallow ponded areas are heavily used as a stop-over and feeding area for migrating waterfowl. Sensitive waterfowl species, such as trumpeter swans and snow and white-front geese, utilize the flats during migration periods in the spring and fall. Numerous research projects have been conducted in ERF as a result of waterfowl poisoning from white phosphorus, a component of some Army munitions. Remedial studies and pilot treatments are being conducted and will continue into the future. As described previously, there are stringent restrictions on the use of ERF due to its history as an impact area and the continued presence of unexploded ordnance.

2.3.4.10 Other Wetlands

Wetlands protection is required by Executive Order 11990, Protection of Wetlands. NEPA is the process used to evaluate projects for wetlands impacts. Any uses of wetlands will be reviewed by the Natural Resources Branch. If necessary, the US Army Corps of Engineers will be consulted to determine whether jurisdictional wetlands are involved. Wetlands management practices are discussed in Chapter 3.

2.3.4.11 Glenn Highway Greenbelt

The seven miles of the Glenn Highway that bisect Fort Richardson is an important scenic roadway in the Anchorage urban area. The area bordering Ship Creek and the Glenn Highway is excluded from most military training activities. The exclusion is needed to protect and maintain the visual barrier between the post and the heavily traveled thoroughfare.

USARAK's goal is to maintain the greenbelt in a condition as pristine as possible and to enhance portions of the greenbelt damaged by development. Where necessary, trees will be planted to screen developed areas, such as the machine gun range and the National Guard site. The Army is committed to protecting the aesthetics of natural forests along the Glenn Highway.

2.3.4.12 Other Special Interest Areas

Fort Richardson has other unique sites that qualify as special interest areas. Special consideration is afforded to areas described below when evaluating projects or activities that might negatively impact them.

2.3.4.12.1 McVeigh Marsh Waterfowl Refuge

McVeigh Marsh is a sensitive and important ecological area where large numbers of waterfowl nest and rear their young. Up to 10 species of waterfowl use McVeigh Marsh. Protection of waterfowl, wetlands, and hydrology are all important factors of consideration in management of McVeigh Marsh.

2.3.4.12.2 Otter Lake and Otter Creek Wildlife and Recreation Area

The Otter Lake vicinity is an important nesting area for diverse waterfowl and songbird populations. The lake is also an important recreation area with overnight camping and day use picnicking facilities. The lake is stocked with rainbow trout each summer, and is an important military and Anchorage area sport fishery. Otter Creek supports important wildlife habitat for silver salmon (spawning and rearing), mink, and river otters.

2.3.4.12.3 Gwen Lake Wildlife and Recreation Area

Gwen Lake and vicinity includes three small lakes that are important wildlife habitats for beaver and waterfowl. Gwen Lake is also a day use picnicking and tent camping area. The lake is stocked with rainbow trout and is an important sport fishery for military and civilians in the Anchorage area. Rainbow trout feed on a rich freshwater shrimp resource and display growth rates in summer that are unrivaled in southcentral Alaska.

2.3.4.12.4 Clunie Lake Wildlife and Recreation Area

Clunie Lake is known for its nesting loons. Protection of remaining habitat for these sensitive waterbirds is of primary importance as human disturbance throughout the Anchorage area is causing significant reductions in their numbers and former territory. Clunie Lake is a designated day use picnicking and camping area. It also is a sport fishery for military and Anchorage area users, with rainbow trout being stocked annually.

2.3.4.12.5 Waldon Lake Wildlife and Recreation Area

Waldon Lake is another lake used by loons. It also is a sport fishery and is stocked with rainbow trout and other species of fish each summer.

2.3.4.12.6 North Fork Campbell Creek Anadromous Fish Stream

The North Fork of Campbell Creek on Fort Richardson is a spawning and rearing area for king salmon. High water quality and low disturbance to spawning grounds must be maintained. Permits are required for any activity that may affect the anadromous features of this creek.

2.3.4.12.7 Chester Creek Anadromous Fish Stream

Chester Creek on Fort Richardson is a spawning and rearing area for silver salmon. High water quality and low disturbance to spawning grounds must be maintained. Permits are required for any activity that may potentially affect the anadromous nature of this creek.

2.4 Cultural Resources

Much of Fort Richardson has not been surveyed for cultural and historic resources. Generally, surveys have been site specific (e.g., Glenn Highway, Malemute Drop Zone, Snowhawk Lake, and Otter Lake) with the exception of Steele (1980) who conducted a low intensity archaeological survey of the entire post. The following information, with exception of Site Summit material, is from Bacon et al. (1986).

Only a relatively small portion of Fort Richardson is considered to be highly sensitive with regard to archaeological resources. These areas include the mouth of Eagle River, the shoreline of Knik Arm, upstream portions of the Ship Creek drainage, the Fossil Creek drainage, Elmendorf Moraine, the 40-90 mm Range, and Grezelka Range. The rest of the post is not considered sensitive.

Historically, the Anchorage area may have been inhabited intermittently for 9,000–10,000 years, although few sites associated with this early occupation have been found. Pacific Eskimos probably occupied the area, at least seasonally, as recently as 300 years ago. The Tanaina Athabaskan Natives initially occupied the area between 1650 and 1780, and there were several Tanaina villages in the Fort Richardson area. Eklutna is the only village still in existence. Most archeological sites on Fort Richardson were probably summer fish camps. It is possible that Russian artifacts could be located on Fort Richardson due to early Russian influence in the Kenai Peninsula and the Interior. A portion of the Iditarod Trail is on Army lands, although its exact location has not been pinpointed.

The seven known cultural resources sites (not including Site Summit) on Fort Richardson are all historic and adds only a few details to the already large body of knowledge on the history of Anchorage. The value of future archeological surveys on Fort Richardson lies in discovering new sites of varying time periods and cultural affiliations. It is likely that such sites exist. Bacon et al. (1986) indicates a priority for future archeological surveys. High priorities include Otter Lake, Gwen Lake, Clunie Lake, the mouth of Eagle River, and streams emptying into Knik Arm, which have not been surveyed, as well as searching for the Iditarod Trail near Otter Lake Recreation Area.

The abandoned Nike Hercules Missile Battery on Site Summit is an important Cold War historic property. It is the only remaining Nike site of the eight built in Alaska that still maintains its historic character as a functional missile battery. It was the last Nike Battery in the nation to be deactivated, in 1979.

A Legacy Resource Management Program grant by the Department of Defense funded a study to inventory, evaluate, develop interpretative materials, and nominate the Nike Hercules Missile Battery at Site Summit to the National Register of Historic Places. This work was completed and the Nike Site was listed by the Keeper of the National Park Service on July 8, 1996.

Phase II of the Legacy grant for the Nike Site provided funding to develop a feasibility study for the management of a cold war Nike Hercules Missile site. The study was completed in December 1997. Recommendations in the study will be used in developing the Fort Richardson Cultural Resources Management Plan.

Only 15 miles from downtown Anchorage, Site Summit rises about 4,000 feet above sea level, providing an incredible scenic view of Anchorage, the Susitna and Cook Inlet basins, and surrounding mountains. It has high potential for being a world class historic and recreational area, offering insights into both the Cold War and alpine tundra. Site Summit is further described in a pamphlet prepared by the Alaska Office of History and Archeology (1996).

Figure 2-1. Fort Richardson Facilities.

Figure 2-2. Fort Richardson Transportation System.

Figure 2-3. Fort Richardson Terrain.

Figure 2-4. Fort Richardson Surface Geology.

Figure 2-5. Fort Richardson Soils.

Figure 2-6. Fort Richardson Surface Waters.

Figure 2-7. Fort Richardson Vegetation.

Figure 2-8. Fort Richardson Wetlands.

Figure 2-9. Fort Richardson Wildlife Habitat.

Figure 2-10. Fort Richardson Moose Habitat.

Figure 2-11. Fort Richardson Special Interest Areas.